DATA SHEET

TEA5551T
1-chip AM radio

Product specification
File under Integrated Circuits, IC01

October 1990

Philips
Semiconductors

PHILIPS

GENERAL DESCRIPTION

The TEA5551T is a 1-chip monolithic integrated radio circuit which is designed for use as a pocket receiver with headphones in a supply voltage range (V_S) of 1.8 V to 4.5 V.

The circuit consists of a complete AM part and dual AF amplifier with low quiescent current. The AF part has low radiation (HF noise) and good overdrive performance. The dual AF amplifier makes the device suitable for operation in an AM/FM stereo receiver with or without stereo cassette player. The IC has a 1-pin switch for AM or other applications.

Features

- Low voltage operation (V_S = 1.8 V to 4.5 V)
- Low current consumption (I_{tot} = 5 mA at V_S = 3 V)
- All pins provided with ESD protection

AM part

- High sensitivity (V_i = 1.5 μV for V_o = 10 mV)
- Good IF suppression
- Good signal handling ($V_{i(max)}$ = 80 mV)
- Switch for AM or other applications
- Short waveband (> 40 MHz)

AF part

- A fixed integrated gain of 32 dB
- Few external components required
- Very low quiescent current
- Low HF radiation and good AF overdrive performance
- 0 to 20 kHz limited frequency response
- 25 mW per channel output power in 32 Ω

QUICK REFERENCE DATA (at T_{amb} = 25 °C)

PARAMETER	CONDITIONS	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply voltage		V_S	1.8	3.0	4.5	V
Supply current		$I_5 + I_{10}$	–	6	–	mA
AM part	m = 0.3					
RF sensitivity						
RF input voltage						
	$V_{o(AF)}$ = 10 mV	$V_{i(RF)}$	–	1.5	–	μV
	S/N = 26 dB	$V_{i(RF)}$	–	15	–	μV
	S/N = 50 dB	$V_{i(RF)}$	–	10	–	mV
AF output voltage	$V_{i(RF)}$ = 1 mV	$V_{o(AF)}$	–	80	–	mV
Total harmonic distortion	$V_{i(RF)}$ = 100 μV to 30 mV	THD	–	0.8	–	%
Signal handling capability	m = 0.8; THD = 10%	$V_{i(RF)}$	–	80	–	mV
AF part	both channels driven					
Output power	R_L = 32 Ω; THD = 10%					
at V_S = 3.0 V		P_o	–	25	–	mW
at V_S = 4.5 V		P_o	–	60	–	mW
Voltage gain	P_o = 10 mW	G_v	–	32	–	dB
Channel separation	1 kHz	α	–	50	–	dB

PACKAGE OUTLINE

16-lead mini-pack; plastic (SO16; SOT109A); SOT109-1; 1996 July 25.

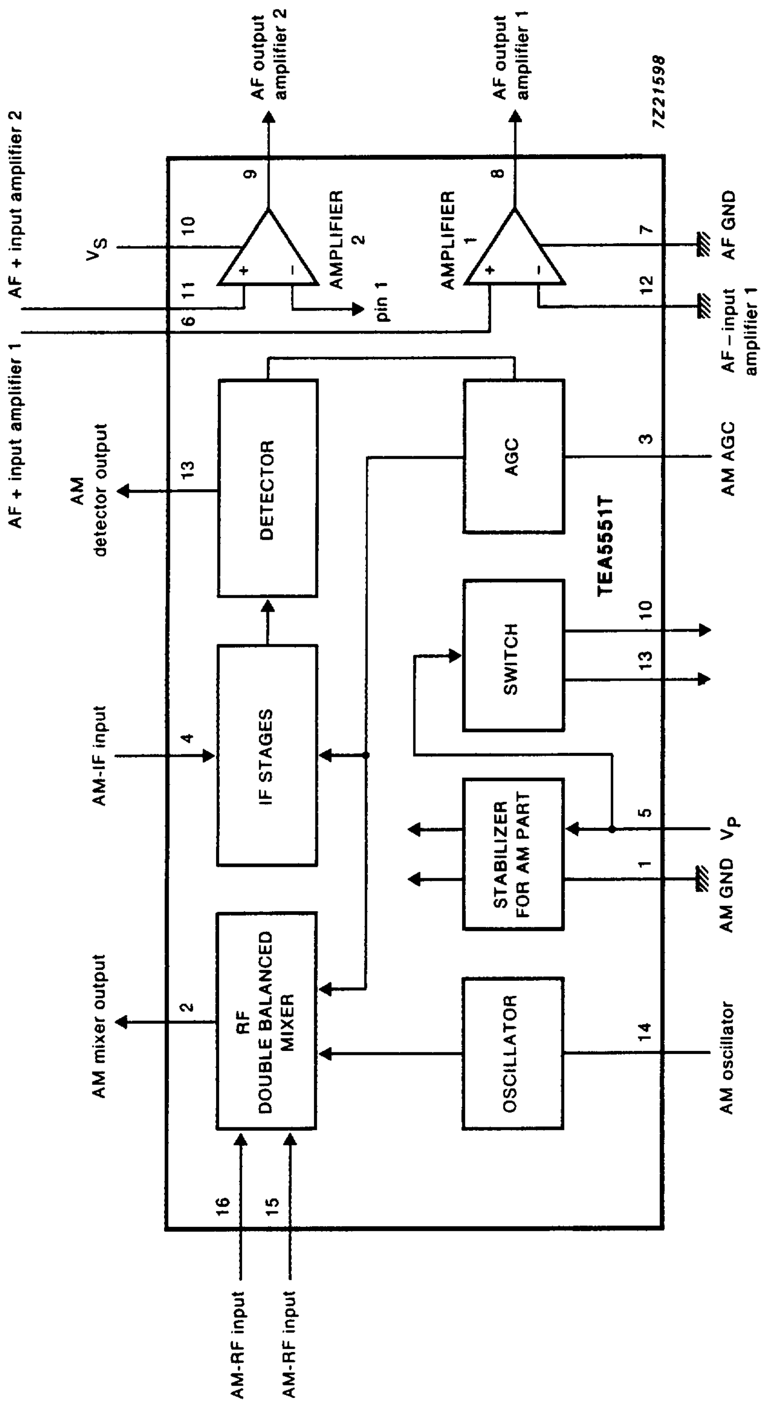


Fig.1 Block diagram.

PINNING

1 AM GND
2 AM mixer output
3 AM AGC
4 AM-IF input
5 AM supply voltage (V_P)
6 AF + input amplifier 1
7 AF GND
8 AF output amplifier 1
9 AF output amplifier 2
10 AF supply voltage (V_S)
11 AF + input amplifier 2
12 AF – input amplifier 1
13 AM detector output
14 AM oscillator
15 AM–RF input
16 AM–RF input

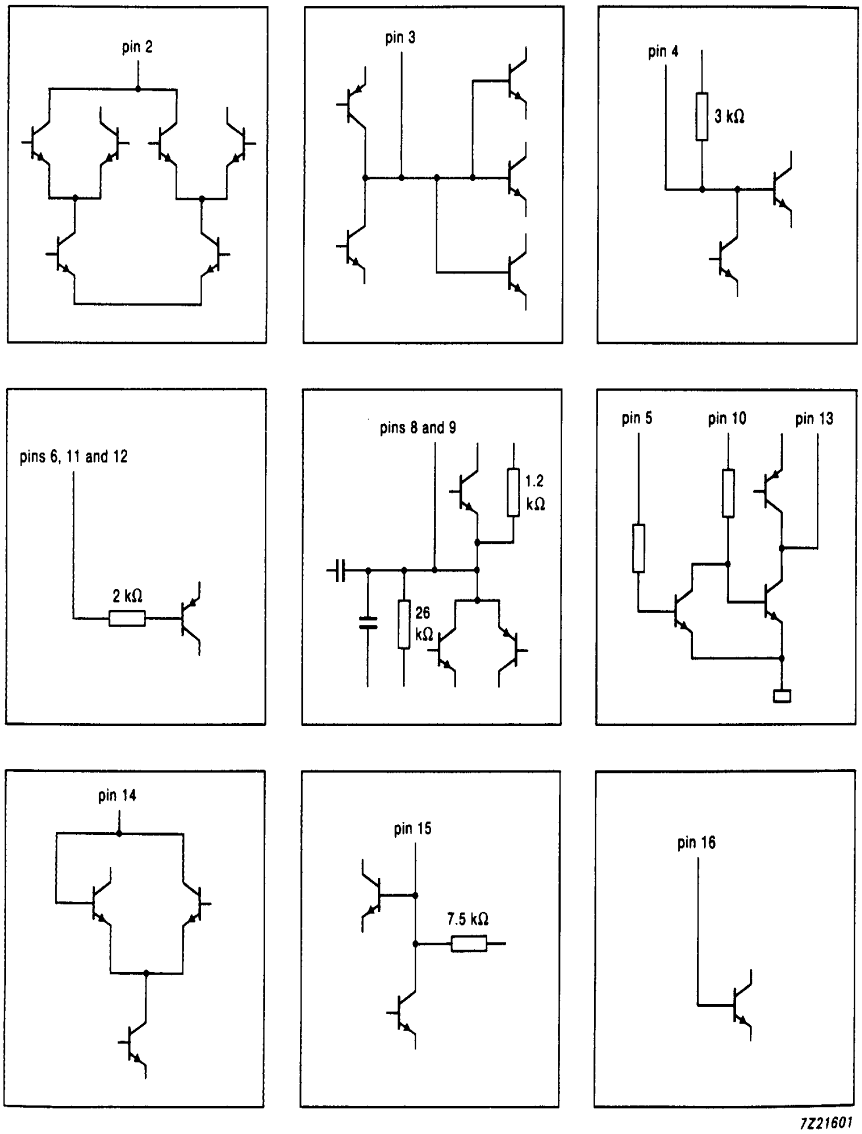


Fig.2 All pins provided with ESD protection diodes to substrate.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

PARAMETER	CONDITIONS	SYMBOL	MIN.	MAX.	UNIT
Supply voltage		V_S	–	6	V
Supply current (peak)		I_M	–	150	mA
Crystal temperature		T_c	–	150	°C
Short-circuit protection	V_S = 4.5 V	t_{sc}	–	5	s
Total power dissipation		P_{tot}	see Fig.3		
Storage temperature range		T_{stg}	–65	+150	°C
Operating ambient temperature range		T_{amb}	–25	+60	°C

QUALITY

In accordance with UZW-BO/FQ-0601.

Operating life endurance verified 2000 hours at T_j = 85 °C.

The product meets the 600 V ESD on all pins (HBM specification UZW-BO/FQ-A302).

THERMAL RESISTANCE

From junction to ambient $R_{th\ j\text{-}a}$ = 110 K/W

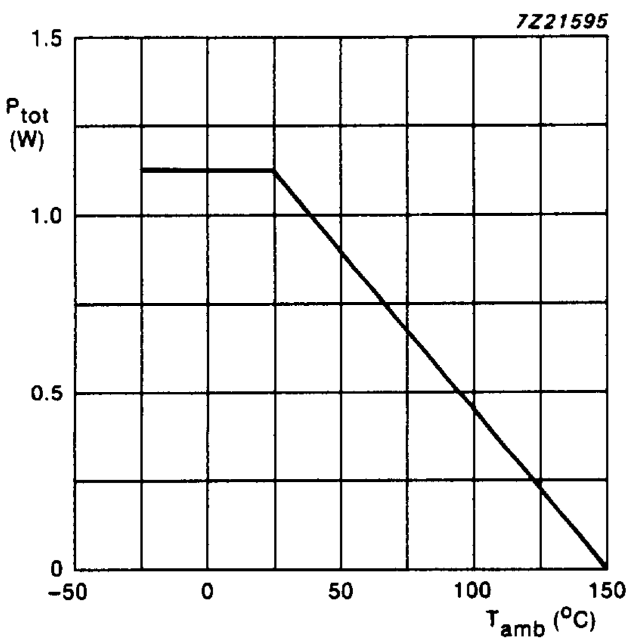


Fig.3 Power derating curve.

DC CHARACTERISTICS

All voltages are referenced to pin 1 and pin 7; all input currents are positive; all parameters are measured in test circuit of Fig.6 at V_S = 3 V; T_{amb} = 25 °C unless otherwise specified

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply voltage	V_S	1.8	3.0	4.5	V
Voltages					
pin 5	V_5	1.6	2.8	4.3	V
pin 10	V_{10}	1.8	3.0	4.5	V
HF part					
Total current consumption (pin 5)	I_5	–	2.2	–	mA
Oscillator current (pin 14)	I_{14}	–	100	–	µA
Mixer current (pin 2)	I_2	–	200	–	µA
Voltages					
pin 3	V_3	–	150	–	mV
pin 13	V_{13}	–	600	–	mV
pin 15	V_{15}	–	1.1	–	V
pin 16	V_{16}	–	1.1	–	V
AF part					
Total current consumption (pin 10)	I_5	–	4.0	–	mA
Input bias current					
(pin 11 connected to pin 16)	$I_{11} + I_{16}$	–	40	–	nA
DC output voltage					
pin 8	V_8	-	1.5	–	V
pin 9	V_9	–	1.5	–	V

AC CHARACTERISTICS

All parameters are measured in test circuit of Fig.6 at V_S = 3 V; T_{amb} = 25 °C unless otherwise specified.
RF conditions: Input frequency 1 MHz; 30% modulation where f_{mod} = 1 kHz; unless otherwise specified.

PARAMETER	CONDITIONS	SYMBOL	MIN.	TYP.	MAX.	UNIT
RF sensitivity						
RF input voltage	$V_{o(AF)}$ = 10 mV	$V_{i(RF)}$	–	1.5	–	μV
Loss in sensitivity	$V_{o(AF)}$ = 10 mV; V_S = 1.8 V	$\Delta V_{i(RF)}$	–	6	–	dB
Noise						
Signal-to-noise ratio for RF input signal voltage of						
$V_{i(RF)}$ = 2 μV		S/N	–	6	–	dB
$V_{i(RF)}$ = 15 μV		S/N	–	26	–	dB
$V_{i(RF)}$ = 1 mV		S/N	–	46	–	dB
AF output voltage						
	$V_{i(RF)}$ = 1 mV	$V_{o(AF)}$	–	80	–	mV
	$V_{i(RF)}$ = 1 mV; V_S = 1.8 V	$V_{o(AF)}$	–	55	–	mV
Total harmonic distortion						
	$V_{i(RF)}$ = 100 μV to 30 mV	THD	–	0.8	–	%
	$V_{i(RF)}$ = 80 mV; m = 0.8	THD	–	10	–	%
AGC range						
Change in RF input voltage for 10 dB change in AF output voltage	$V_{i(RF1)}$ = 50 mV	$V_{i(RF1)}/V_{i(RF2)}$	–	86	–	dB
Optimum source impedance		Z_{source}	–	3	–	kΩ
IF suppression						
at $V_{o(AF)}$ = 10 mV	note 1	α	–	20	–	dB
Oscillator (pin 14)	f_{osc} = 1468 kHz					
Oscillator voltage		V_i	–	100	–	mV
	V_5 = 1.5 V	V_i	–	*	–	mV

Note to the AC characteristics

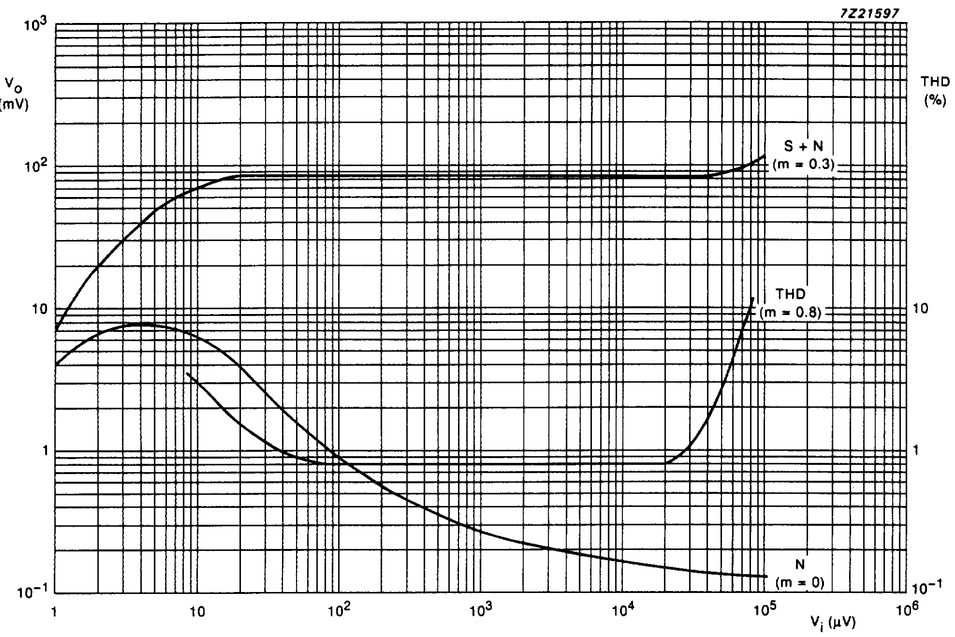
1. $$\alpha = \frac{V_i \text{ at } f_i = 468\text{ kHz}}{V_i \text{ at } f_i = 1\text{ MHz}}$$

* Value to be fixed.

AC CHARACTERISTICS

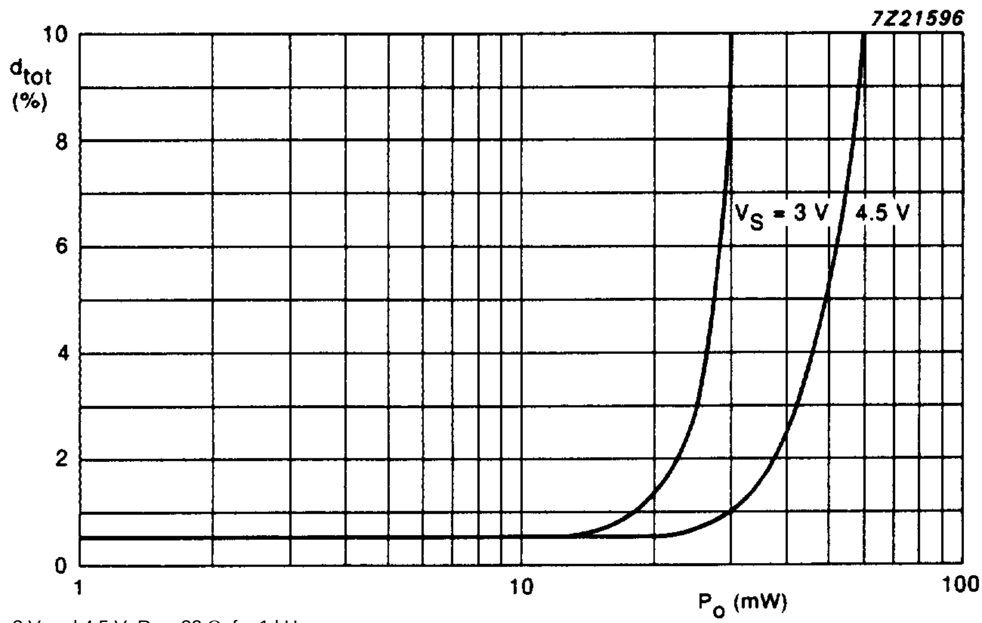
All parameters are measured in test circuit of Fig.6 at V_S = 3 V; T_{amb} = 25 °C unless otherwise specified. RF conditions: f = 1 kHz; R_L = 32 Ω; unless otherwise specified.

PARAMETER	CONDITIONS	SYMBOL	MIN.	TYP.	MAX.	UNIT
Output power						
	THD = 10%	P_o	–	25	–	mW
	THD = 10%; V_S = 1.8 V	P_o	–	8	–	mW
	THD = 10%; V_S = 4.5 V	P_o	–	60	–	mW
Total harmonic distortion	P_o = 10 mW	THD	–	0.5	–	%
Voltage gain	P_o = 10 mW	G_v	–	32	–	dB
Noise						
Noise output voltage	R_S = 5 kΩ; B = 15 kHz	V_{no}	–	240	–	μV
HF noise output voltage	R_S = 5 kΩ; B = 5 kHz; f = 500 kHz	$V_{no(RF)}$	–	20	–	μV
Input circuit						
Input impedance	pin 11 connected to pin 12	Z_i	–	3	–	MΩ
Mute switch						
AC impedance (pin 13 to ground)	V_5 = 0 V; I_{13} = 0.32 mA	R_S	–	200	–	Ω



Conditions: f_o = 1 MHz; f_m = 1 kHz; V_S = 3 V; R_g = 50 Ω; m = 0.3 (unless otherwise specified).

Fig.4 Typical signal (S) and noise (N) output voltages, where V_o is the AF output voltage at pin 13, as a function of the input voltage V_i. V_i is the input voltage at pin 16. Also shown is the total harmonic distortion (THD).



Conditions: V_S = 3 V and 4.5 V; R_L = 32 Ω; f = 1 kHz.

Fig.5 Total distortion (d_{tot}) as a function of output power (P_o).

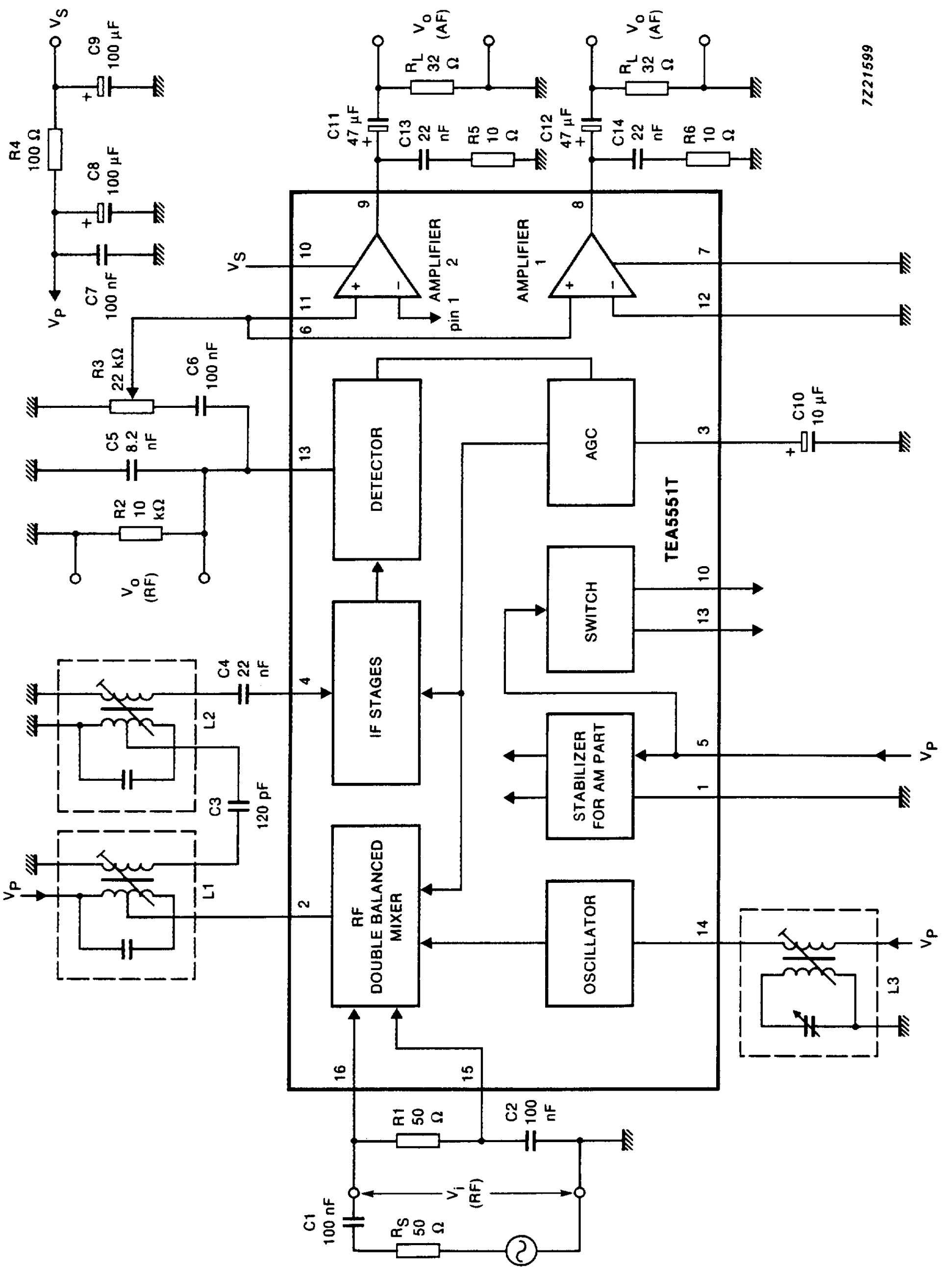
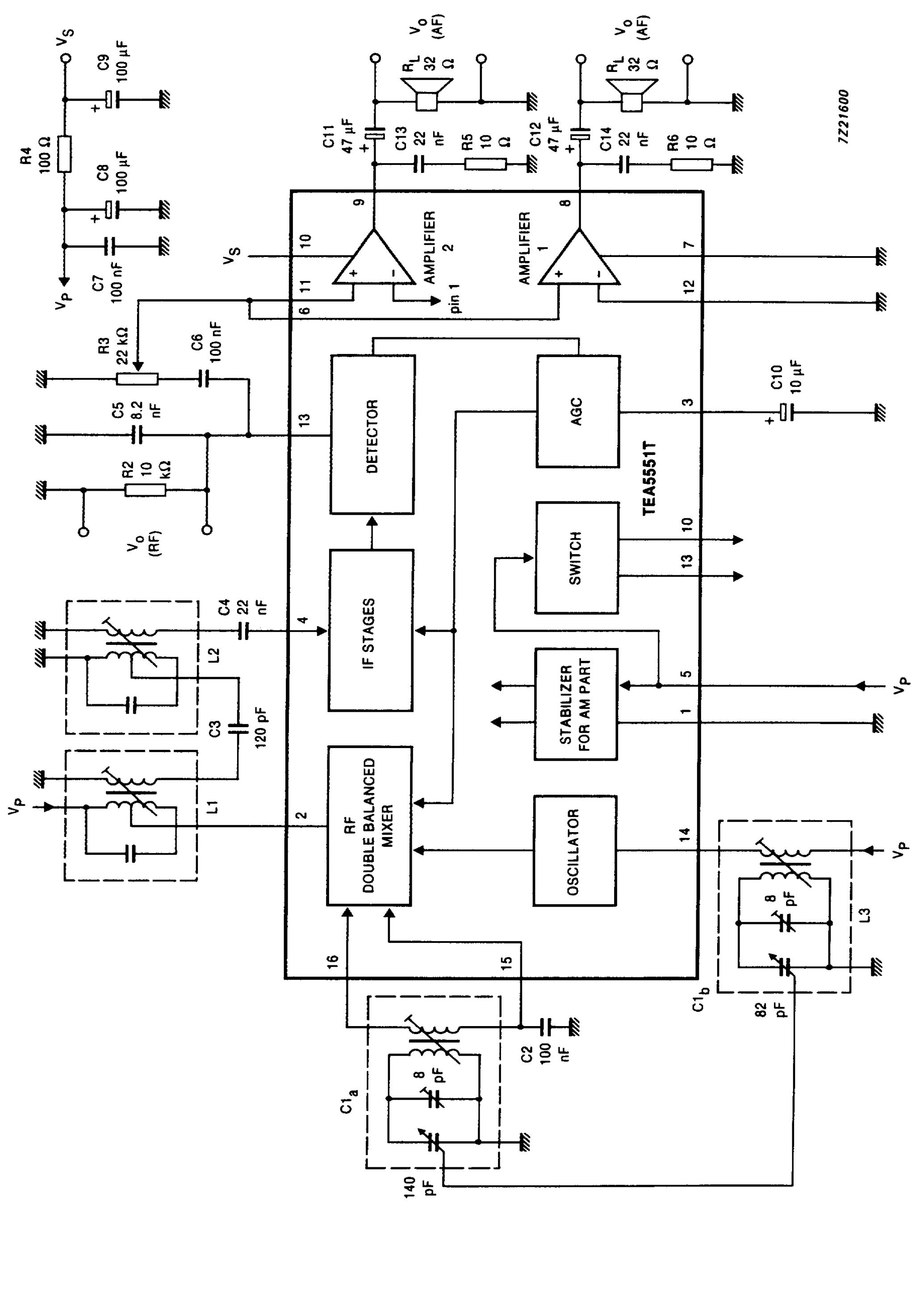


Fig.6 Test circuit.

Coil data:

L1	7MCS2199
L2	7MCS2197
L3	7BRS10869X

APPLICATION INFORMATION



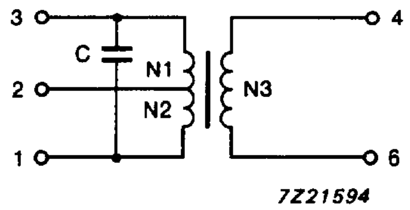
Coil data:

L1	7MCS2199
L2	7MCS2197
L3	7BRS10869X

Fig.7 Application circuit.

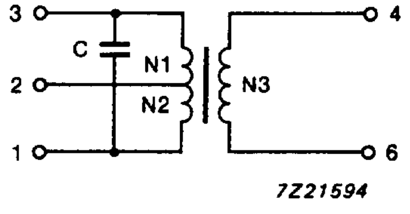
COIL DATA

AM coils (Figs 6 and 7)



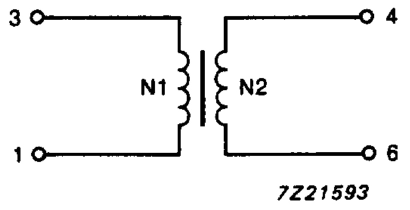
N1 = 60
N2 = 80
N3 = 15
C = 180 pF (internal)
L1–L3 = 643 μH
Qo = 110
Wire = 0.07 mm dia.
Coil type 7P–TOKO
Material 7MC

Fig.8 IF bandpass filter (L1). TOKO sample no. 7MCS2199.



N1 = 125
N2 = 15
N3 = 6
C = 180 pF (internal)
L1–L3 = 643 μH
Qo = 110
Wire = 0.07 mm dia.
Coil type 7P–TOKO
Material 7MC

Fig.9 IF bandpass filter (L2). TOKO sample no. 7MCS2197.

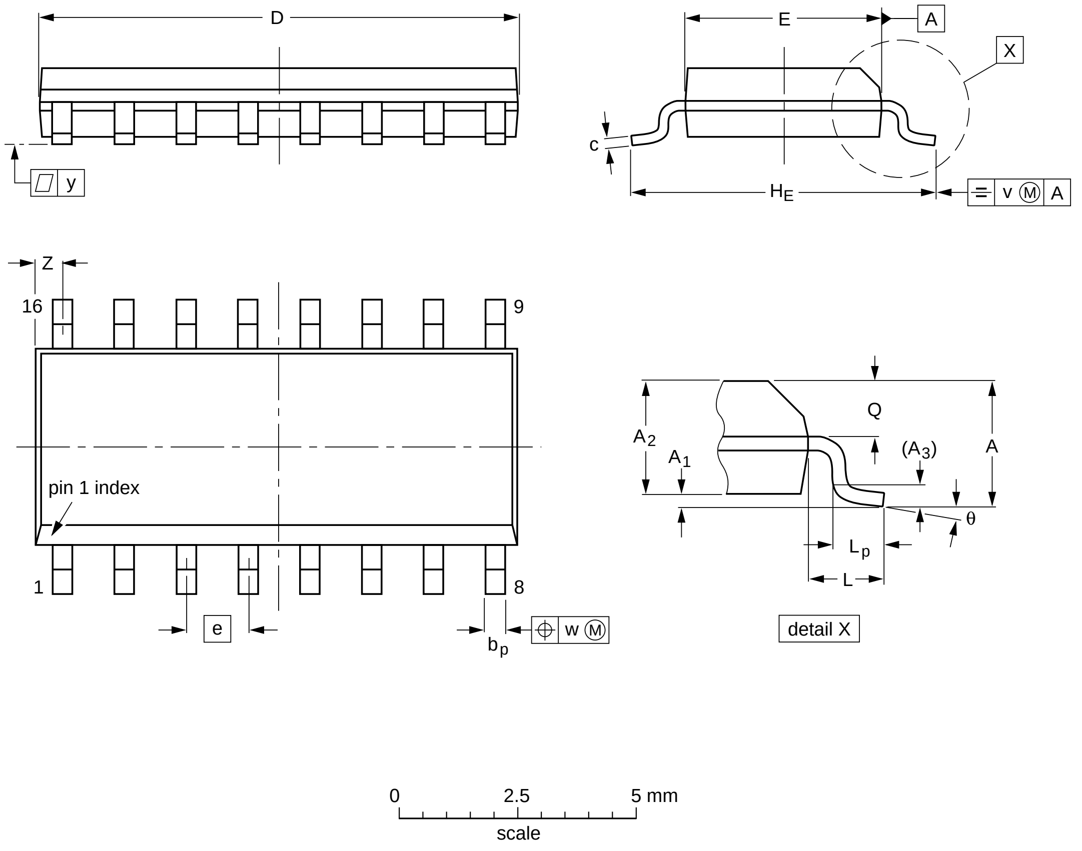


N1 = 90
N2 = 6
L1–L3 = 295 μH
Qo = 110
Wire = 0.07 mm dia.
Coil type 7P–TOKO
Material 7BR

Fig.10 Oscillator coil (L3). TOKO sample no. 7BRS10869X.

PACKAGE OUTLINE

SO16: plastic small outline package; 16 leads; body width 3.9 mm **SOT109-1**



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	10.0 9.8	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8^o 0^o
inches	0.069	0.0098 0.0039	0.057 0.049	0.01	0.019 0.014	0.0098 0.0075	0.39 0.38	0.16 0.15	0.050	0.24 0.23	0.041	0.039 0.016	0.028 0.020	0.01	0.01	0.004	0.028 0.012	

Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT109-1	076E07S	MS-012AC				~~91-08-13~~ 95-01-23

SOLDERING

Introduction

There is no soldering method that is ideal for all IC packages. Wave soldering is often preferred when through-hole and surface mounted components are mixed on one printed-circuit board. However, wave soldering is not always suitable for surface mounted ICs, or for printed-circuits with high population densities. In these situations reflow soldering is often used.

This text gives a very brief insight to a complex technology. A more in-depth account of soldering ICs can be found in our *"IC Package Databook"* (order code 9398 652 90011).

Reflow soldering

Reflow soldering techniques are suitable for all SO packages.

Reflow soldering requires solder paste (a suspension of fine solder particles, flux and binding agent) to be applied to the printed-circuit board by screen printing, stencilling or pressure-syringe dispensing before package placement.

Several techniques exist for reflowing; for example, thermal conduction by heated belt. Dwell times vary between 50 and 300 seconds depending on heating method. Typical reflow temperatures range from 215 to 250 °C.

Preheating is necessary to dry the paste and evaporate the binding agent. Preheating duration: 45 minutes at 45 °C.

Wave soldering

Wave soldering techniques can be used for all SO packages if the following conditions are observed:

- A double-wave (a turbulent wave with high upward pressure followed by a smooth laminar wave) soldering technique should be used.
- The longitudinal axis of the package footprint must be parallel to the solder flow.
- The package footprint must incorporate solder thieves at the downstream end.

During placement and before soldering, the package must be fixed with a droplet of adhesive. The adhesive can be applied by screen printing, pin transfer or syringe dispensing. The package can be soldered after the adhesive is cured.

Maximum permissible solder temperature is 260 °C, and maximum duration of package immersion in solder is 10 seconds, if cooled to less than 150 °C within 6 seconds. Typical dwell time is 4 seconds at 250 °C.

A mildly-activated flux will eliminate the need for removal of corrosive residues in most applications.

Repairing soldered joints

Fix the component by first soldering two diagonally-opposite end leads. Use only a low voltage soldering iron (less than 24 V) applied to the flat part of the lead. Contact time must be limited to 10 seconds at up to 300 °C. When using a dedicated tool, all other leads can be soldered in one operation within 2 to 5 seconds between 270 and 320 °C.

DEFINITIONS

Data sheet status	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
Limiting values	
Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.	
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

LIFE SUPPORT APPLICATIONS

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.